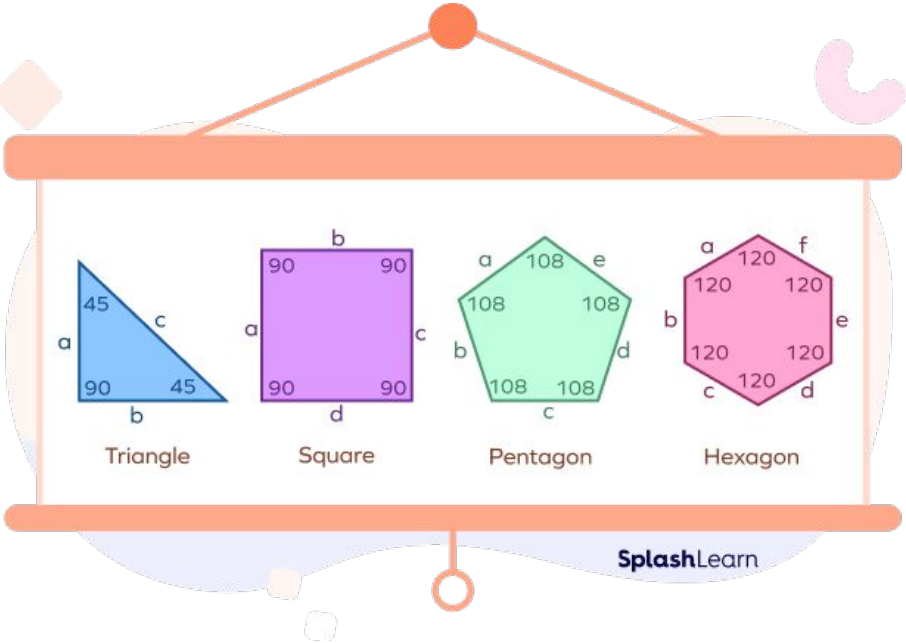
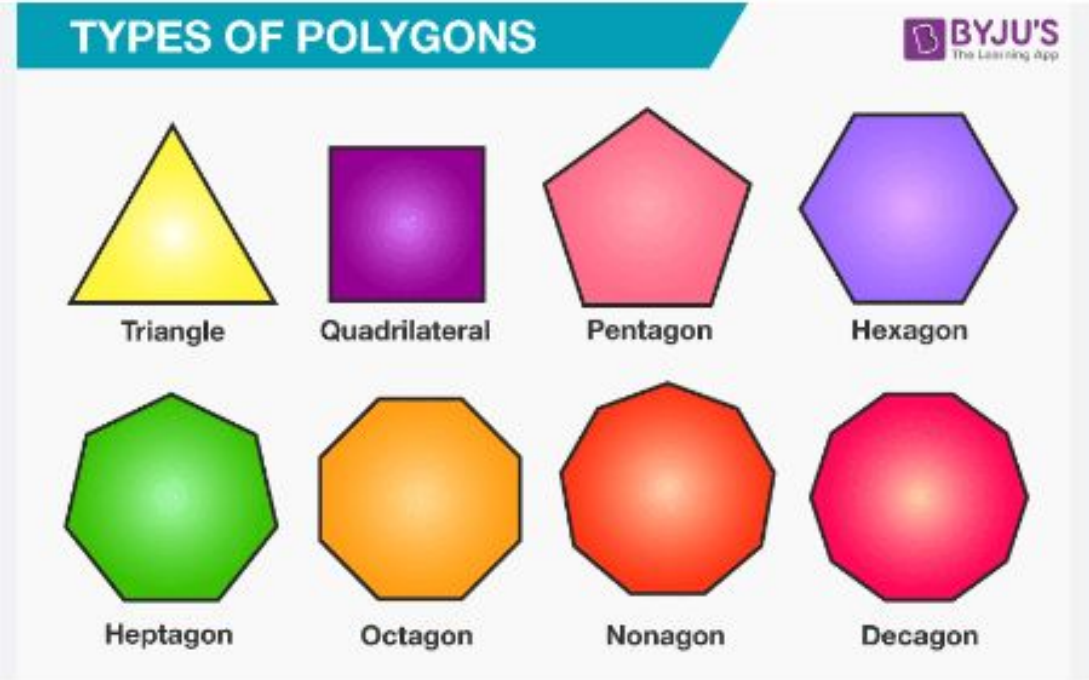
Class 3: Geometry In Action

To make the robot draw the desired shape, we need to know the **turning angle**. Geometry is the study of angles. Let's put our knowledge of Geometry to work!!!



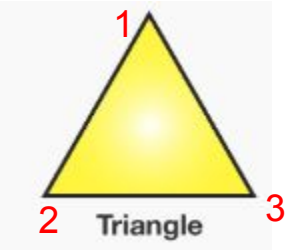
Charles Sun 2022

Question: How do we find the **inner angles** of any **regular polygons**? By “regular”, I mean inner angles are the same. For example, **pentagon** and **hexagon** are regular polygons.



Observation

Let n = number of inner angles of a regular polygon.



n = 3
Sum of all inner angles = 180
Each inner angle = **180/n= 60**

n = 4
Sum of all inner angles = 360
Each inner angle = **360/n= 90**

Our Hypothesis…

Sum of all inner angles = 180*(n-2)

Thus each inner angle = 180*(n-2) /n

Test our hypothesis on https://skulpt.org/

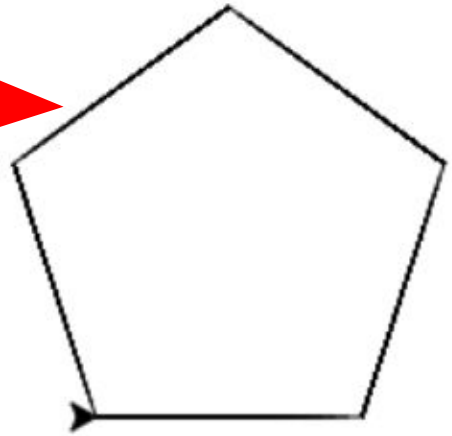
n=5
Sum = 180*(n-2)=540
Inner angle=540/5=**108**

```
from turtle import *

pendown()

for x in range(5):
  forward (100)
  left(180-108) # cmpl

penup()
```



YES !!!

How about n=6,7,8,9,10?

Computer Science & Math: Concept: **Variables**

Let's use **variables** in our program so it can work with any integer n for the number of inner angles…

Does that work? Try it…

```
from turtle import *

# define # of inner angles
n=6

### calculate each turn
sum_angles = 180*(n-2)
inside_angle = sum_angles/n
left_turn_angle = 180-inside_angle

### draw
pendown()
for x in range(n):
  forward (20)
  left(left_turn_angle)
penup()
```

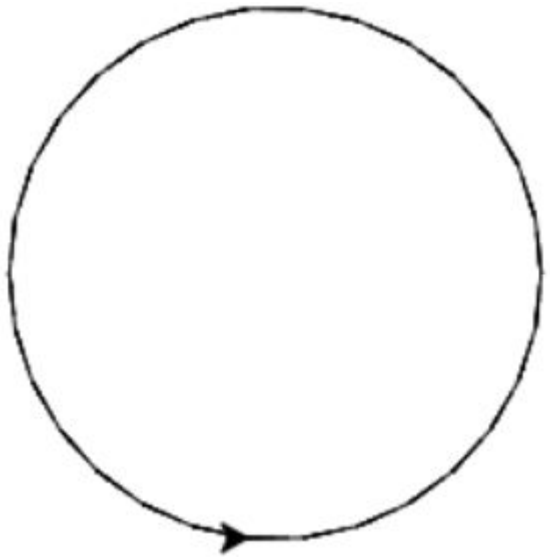
Computer Science & Math: Concept: **Algorithm**

What if we make **n=30**, what do you see?

Does that look like a circle as we increase the number of inner angles?

Can we use that algorithm to create a circle? or a curve?

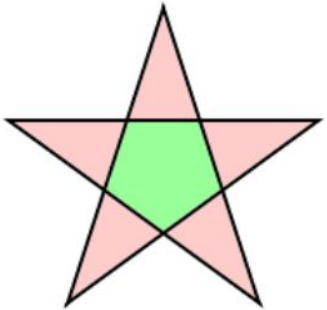
Try it !!!

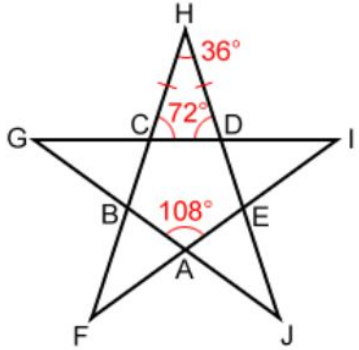


How about the inner angle for a 5-point star (Pentagram)?

Pentagram is a popular shape, used in many national flags…

Hint: There is a Pentagon inside with 108 deg inner angle as we learned previously. Using complementary angles HCD & HDC, we can calculate the inner angle on each point to be 36 degrees.





Assignment:

Write a TurtleBot program that draws your initials on paper. Make it as pretty as possible using techniques you learned in the past classes. Turn in the paper for grading.